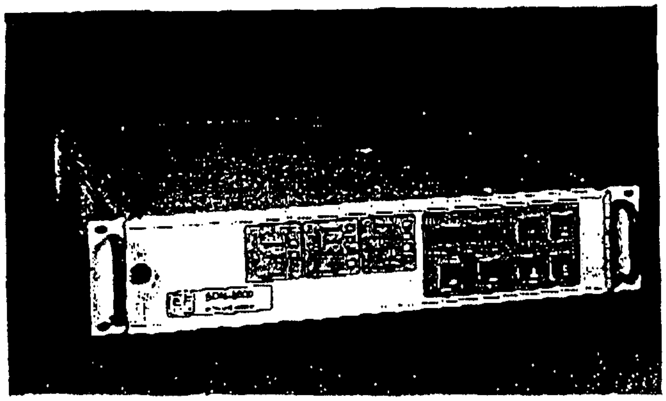
DOCUMENT #4



CALIFORNIA MICROWAVE

EFData is a California Microwave Subsidiary.

EF DATA

SDM-8000

SATELLITE MODEM

- IDR/IBS
- Closed Network
- 9.6 Kbps to 9.312 Mbps

EFData's single chassis SDM-8000 satellite modem meets all requirements of the IESS-308 and 309 specifications for the Intermediate Data Rate (IDR), Intelsat Business Specifications (IBS), and EUTELSAT SMS requirements. The SDM-8000 can also be used for any closed network application.

ALL APPLICATIONS

Switching from one open network application to another is very simple with the SDM-8000. In most cases, switching can be done from the front panel. EFData also provides an optional sequential decoder to complement the SDM-8000. Multiple filter masks, selected at the front panel, ensure end-to-end compatibility with other manufacturer's modems in closed network environments.

MAXIMUM FLEXIBILITY

The SDM-8000 can be configured to *any* data rate ranging from 9.6 Kbps to 9.312 Mbps, in one bit-per-second steps. Each rate meets standard FEC code rates. Selection of data rates can be done from the front panel. The modem contains an *internal* channel unit, that includes both IDR and IBS overhead framing units. The framing unit, with D&I option installed, is fully functional at all specified rates for IDR (64 to 8448 Kbps) and IBS (64 to 2048 Kbps) data rates.

ALL INTERFACES

A full range of industry standard digital interfaces (G.703, V.35, or MIL-188/RS-422) are built into the modem. Interface selection is a simple matter of moving jumpers. EFData provides the IB-8004 optional breakout panel for convenient access to all components of the IDR and IBS Engineering Service Channels (ESC) via built-in standard connectors and terminal blocks. An IESS-308 Rev. 6 compliant Drop and Insert (D&I) option is also available.

MONITOR AND CONTROL

The SDM-8000 has been equipped with an improved, more extensive Monitor and Control (M&C) system than its predecessors. Each modem subsystem has its own M&C microprocessor controlled by the host processor located on the M&C board. The microprocessor/host processor greatly enhances the flexibility of the SDM-8000. The M&C is compatible with the software versions of other EFData modems currently in the field.

ENERGY AND BANDWIDTH EFFICIENT

Forward error correction, utilizing convolutional encoding and soft decision Viterbi K=7 decoding, yields high performance at low E_b/N_0 levels, while occupying minimal bandwidth. An optional sequential decoder is also available for closed network applications. Code rates of 1/2, 3/4, and 7/8 are supported by both decoders. Concatenated Reed-Solomon decoding is available as a field upgradeable option.

MONITOR AND CONTROL

All M&C functions controlled and monitored at the front panel keyboard are also programmable through the remote RS-232 or RS-485 serial interface. Modems can be individually addressed from 1 to 255. Address 0 is reserved for global addressing. Modem configuration is stored in non-volatile memory that is maintained up to one year without external power.

BACKUP SWITCHING

Different types of protection switches are available to satisfy all installation configurations. Fully automatic 1:1 redundancy and M:N protection (M = 1 or 2, N = 1 to 8) are available. These systems are capable of backing up to eight modems operating on different transponders. Switches and modems are also available in completely assembled and tested racks. The SDM-8000 will also interoperate in a redundant system with other models of EFData modems.

ERROR FREE EF DATA

"Your Error Free Choice"

EFData Corporation
2105 West Fifth Place
Tempe, Arizona U.S.A. 85281
Tel. (602) 968-0447
Fax. (602) 921-9012

SDM-8000 SPECIFICATIONS

System Specifications

Operating Frequency Range	50 to 180 MHz, in 2.5 kHz steps
Digital Interface	G.703, MIL-188/RS-422 and V.35 selectable
Digital Data Rate	9.6 Kbps to 9.312 Mbps, in 1 bit/s steps
Plesiochronous Buffer	32 to 262, 144 bits, selectable from front panel
Forward Error Correction	Rate = 1/2, 3/4, or 7/8 Viterbi, K=7
Data Scrambling	IESS-308 (V.35), IESS-309 or none, selectable from front panel
Prime Power	90 to 264 VAC, 47 to 63 Hz, 100W
Size	19" W x 20" D x 3.5" H (2 RU)
Weight	< 30 lbs.
Agency Approvals	EN 55022, Class B, EN 60950, EN 50082-1
Modulation Type	BPSK, QPSK, (8PSK or 16QAM Options)

Modulation Specifications

Output Power	-5 to -30 dBm, adjustable in 0.1 dB steps
Output Spurious/Harmonics	-55 dBc, 0 to 500 MHz
Output Impedance	75Ω (50Ω optional)
Output Return Loss	20 dB
Data Clock Source	Internal or external
Internal Stability	± 1 x 10^{-5}

Demodulation Specifications

Input Power (Desired Carrier)	-30 to -55 dBm (≤ 2 Mbps) -30 to -45 dBm (> 2 Mbps)
Maximum Composite	-5 dBm or +40 dBc
Input Impedance	75Ω (50Ω optional)
Input Return Loss	20 dB
Carrier Acquisition Range	± 25 kHz, selectable

Guaranteed BER for E_b/N_0

	Specification			Typical		
BER	1/2	3/4	7/8	1/2	3/4	7/8
10^{-3}	4.2	5.3	6.3	3.9	4.6	5.8
10^{-4}	4.7	6.1	7.2	4.1	5.4	6.5
10^{-5}	5.4	6.8	8.0	4.6	6.0	7.2
10^{-6}	6.1	7.6	8.7	5.3	6.8	7.9
10^{-7}	6.7	8.3	9.4	5.9	7.5	8.6
10^{-8}	7.2	8.8	10.2	6.4	8.0	9.4

Environmental

Operating Temperature	0 to 50°C
Humidity	Up to 95%, non-condensing

ESC Specifications

IDR	
Voice Orderwire	2 ADPCM (Input: 4-wire VF)
Data Orderwire	8 Kbps (RS-422 interface)
Backward Alarms	Form C contacts (4)
Total Overhead	96 Kbps
IBS	
Async Data Orderwire	1/2000 x customer data rate
Backward Alarm	Form C contact
Total Overhead	1/15 x customer data rate

Remote Control Specifications

Serial Interface	RS-485 or RS-232
Signals Controlled/Monitored	Transmit Frequency Receive Frequency Transmit Power Transmitter ON/OFF Data Rate Select RF Loopback IF Loopback Data Loopback Scrambler ON/OFF Raw Error Rate Receive Carrier Detect Receive Signal Level Power Supply Voltages Fault Status Error Threshold Alarm Four Backward Alarms

Available Options

Sequential soft decision decoder
Concatenated Reed-Solomon Codec
2 x 10^{-7} internal stability for IF and data clock w/external reference input port
8PSK and 16QAM
Optional high output power at +5 dBm to -20 dBm
Drop and Insert:

Interface	G.703
Data Rate	T-1 or E-1
n x 64	n = 1, 2, 4, 6, 8, 12, 16, 24, 30, or 32

ASYNC/AUPC

CALIFORNIA MICROWAVE

ISO 9001 SGS

ERROR FREE EF DATA

"Your Error Free Choice"

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7/95

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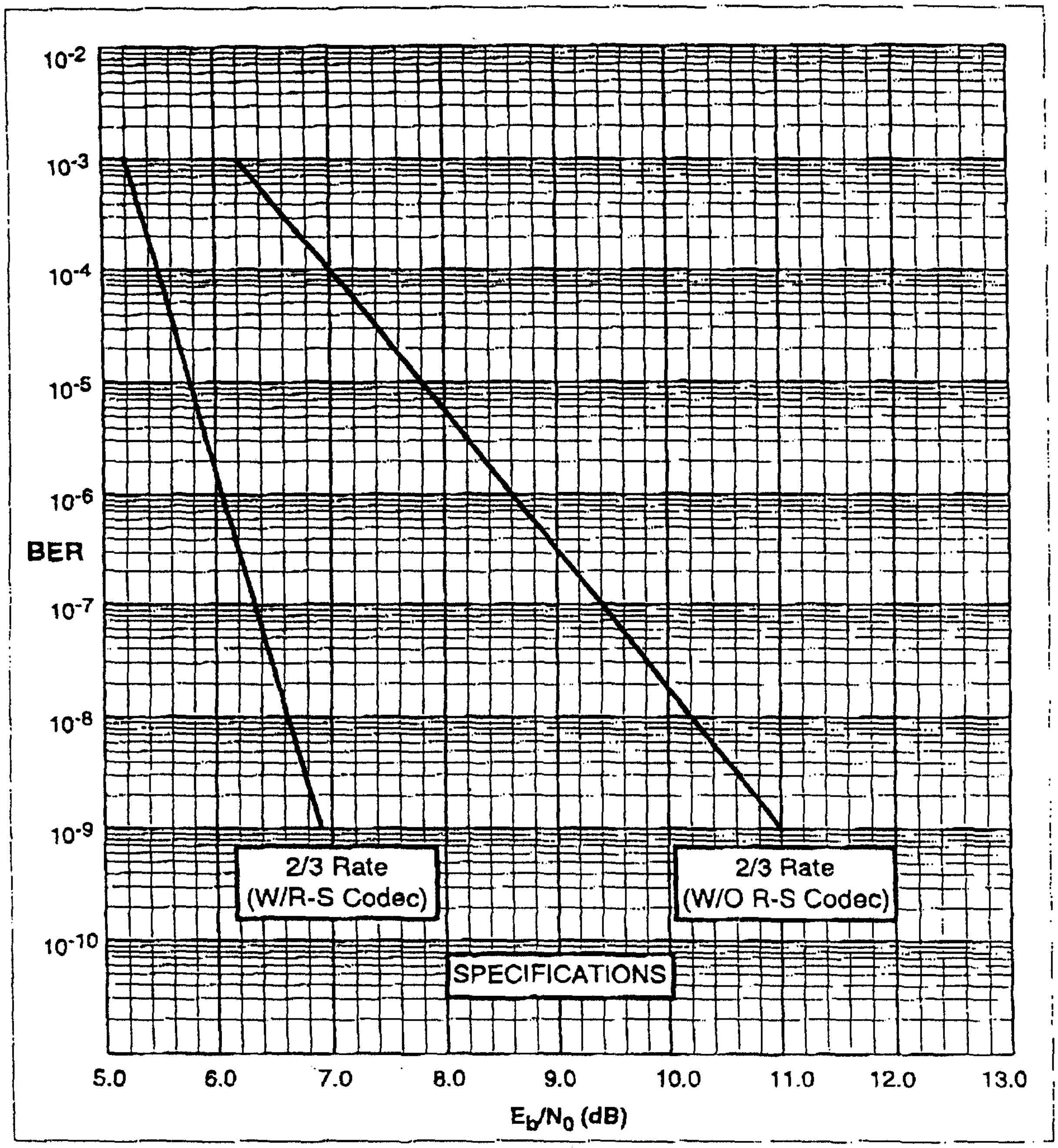

Figure 1-5. 8PSK BER Performance Curves

1.4.2.5 8PSK and 16QAM (with Viterbi Decoder)

Table 1-8 shows the 8PSK and 16QAM specification for the E_b/N_0 required to achieve 10^{-3} to 10^{-8} BER with the Viterbi decoder. Refer to Figure 1-8 (8PSK) and Figure 1-9 (16QAM) for the BER curves with and without the Reed-Solomon option.

Table 1-8. 8PSK and 16QAM BER Data (with Viterbi Decoder)

BER	Specification			Typical		
	8PSK 2/3 Rate	16QAM 3/4 Rate	16QAM 7/8 Rate	8PSK 2/3 Rate	16QAM 3/4 Rate	16QAM 7/8 Rate
10^{-3}	6.2 dB	8.2 dB	9.6 dB	5.6 dB	7.6 dB	9.0 dB
10^{-4}	7.0 dB	9.1 dB	10.4 dB	6.4 dB	8.5 dB	9.8 dB
10^{-5}	7.8 dB	10.0 dB	11.2 dB	7.2 dB	9.4 dB	10.6 dB
10^{-6}	8.7 dB	10.8 dB	12.0 dB	8.1 dB	10.2 dB	11.4 dB
10^{-7}	9.5 dB	11.7 dB	12.8 dB	8.9 dB	11.1 dB	12.2 dB
10^{-8}	10.2 dB	12.6 dB	13.6 dB	9.7 dB	12.0 dB	13.0 dB

DOCUMENT #5

TELEFAX

BOSCH

To

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Raj Singh, Bill Berkman
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Your ref.:

Von/From

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Dept.: UC-RF/PPM
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Date: 13.01.97

Copy to:

UC-Ref.: FAXRUE77.DOC

Subject: C/N versus Eb/No

The digital demodulator shows the following performance, expressed as C/(N+I):

BER	Necessary C/(N+I) [dB]				
Modulation	QPSK	QPSK	QPSK	8-TCM	16-TCM
Coding Rate	1/2	3/4	7/8	2/3	3/4
1.0E-08	6.9	9.8	11.7	12.5	18.5
1.0E-07	6.3	9.0	10.9	11.7	18.1
1.0E-06	5.6	8.3	10.3	10.9	17.4
1.0E-05	4.9	7.5	9.6	10.1	16.8
1.0E-04	4.1	6.8	8.8	9.2	16.2
1.0E-03	3.3	6.1	8.1	8.4	15.4

Via the formula:

$$\frac{C}{N} = \frac{E_b}{N_o} - 10 \times \log\left(\frac{Bandwidth}{DataRate + OverHead}\right)$$

$$Bandwidth = \frac{DataRate + OverHead}{FECrate \times N}$$

$$\begin{aligned} N &= 2 \quad for\ QPSK \\ &= 3 \quad for\ 8PSK \\ &= 4 \quad for\ 16PSK \end{aligned}$$

these C/(N+I)-values can be converted into the more common values of E_b/N_o:

TELEFAX

BOSCH

BER	Necessary $E_b/(N_o+I_o)$ [dB]				
Modulation	QPSK	QPSK	QPSK	8-TCM	16-TCM
Coding Rate	1/2	3/4	7/8	2/3	3/4
1.0E-08	6.9	8.0	9.2	9.4	13.7
1.0E-07	6.3	7.2	8.4	8.6	13.3
1.0E-06	5.6	6.5	7.8	7.8	12.6
1.0E-05	4.9	5.7	7.1	7.0	12.0
1.0E-04	4.1	5.0	6.3	6.1	11.4
1.0E-03	3.3	4.3	5.6	5.3	10.6

In the linkbudgets the Eb/No-values give immediately the information for changing the modulation scheme, e.g. if you change from 16-TCM to QPSK-3/4, the link margin inproves by about 6 dB. Using the same frequency, this additional link margin can be used to increase the distance - but not by factor 2, but less, since the margin has to be splitted up between larger distance and the higher rain losses due to this larger distance. This means, that the correlation between better link margin and larger distance varies with the rain zone, path length, availability, etc.

Reed-Solomon coding would in theory bring a an additional margin of 1.5 to 2 dB, but on the other side the delay - especially for lower data rates - would be rather large, and the extreme sensitivity and very sharp threshold would hardly allow to base the power control concept on the bit error rate, as it is the case in the present design.

Kind regards

Wolfgang Rümmer

Wolfgang Rümmer

DOCUMENT #6

ASSOCIATED COMMUNICATIONS, L.L.C.
11 Canal Center
Alexandria, Virginia 22314
Phone 703-299-4400 Fax 703-299-4580

TO: Mr. Steve Sharkey, FCC

FAX #: (202) 418-0765

DATE: 1/14/97 **PAGES INCLUDING COVER:** 3

RE:

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DIGITAL SERVICES CORPORATION
2300 Clarendon Blvd.
Suite 800
Arlington, VA 22201
(703) 528-8737

January 14, 1997

Mr. Steve Sharkey
Acting Chief
Satellite Engineering Branch
Federal Communications Commission
2000 M Street, Room 512
Washington, DC 20554

Via Facsimile

Re: **<u>Digital Electronic Message Services</u>**

Dear Steve:

In our meeting on January 13, 1997, you requested the following additional information regarding the point to multi-point DEMS system. I would again ask for confidential treatment as this information is proprietary and reflects not just our commercial plans but those of our supplier as well.

1. Based upon a 99.99% reliability, 5 Km path, and rain zone K (typical rain zone) the required rain fade margin at 18 Ghz is 17.5dB and at 24Ghz would be 27dB. Therefore, one needs an additional 9.5 dB incremental link budget to compensate for the increased rain attenuation at 24 Ghz. Additionally, one needs to compensate for the 2.35 dB increased free space loss due to the frequency shift from 18 Ghz to 24 Ghz. Therefore a total of 11.85 dB (9.5 dB plus 2.35 dB) is required to compensate for the shift from 18 Ghz to 24 Ghz.

2. The power back-off required from the in-bound link (from customer premise equipment to node) to implement Dynamic Bandwidth Allocation (DBA) as compared to Fixed Bandwidth Allocation (FBA) depends on the total number of modems at a customer premise location equipment (CPE) to meet the maximum capacity at that location. Both DBA and FBA allow the operation of multiple modems at the CPE. Depending on the number of modems at the CPE, this power back-off number can range from 2 dB to 5 dB when using FBA instead of DBA. For our calculations we have assumed a typical average gain of 3 dB when using FBA instead of DBA.

3. While utilizing FBA improves the link budget margin by 3dB, it significantly reduces the available capacity when compared to utilizing DBA Capacity loss by implementing FBA rather than DBA depends upon the statistical nature of customer traffic requirements of voice and data as well as the grade of service being offered. If all the capacity needed was assigned to a CPE utilizing FBA, Ericsson has told us that the loss in capacity can be as high as five times. However, when considering a mix of traffic where any given customer will always need some minimum amount of capacity with only the incremental traffic demands met through the use of DBA, we have calculated the loss in capacity to be 2.2x when utilizing FBA instead of DBA.

4. Saturated transmitter output power at 18 Ghz is 17 dBm. Saturated transmitter power at 24 Ghz is 1.0 dB less than saturated transmitter power at 18 Ghz.

Should you require additional information or have further questions, please do not hesitate to call.

Very truly yours,

R Singh

Dr. Rajendra Singh

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DOCUMENT #7

Overview of Fixed Broadband Wireless Local Loop System Using 18 GHz DEMS Band vs. 24 GHz Band

Comparison of Performance Characteristics

18 GHz DEMS Key Parameters

Utilizes state-of-the-art technologies and system design to maximize coverage and capacity and to achieve satisfactory economics using approximately 100 MHz

- **Broadband, sectorized, multinodal point-to-multipoint infrastructure**
  - 8 sector, 4 to 6 kilometer radius, overlapping cells
- **Primary utilization of highly efficient modulation scheme**
  - 16-TCM
- **Dynamic bandwidth allocation (DBA)**
  - Continuous reallocation of bandwidth based on customers' instantaneous requirement. DBA utilizes trunking efficiencies by aggregating traffic from multiple users
- **High Reliability**
  - 99.99% or greater

Effects of Moving to 24 GHz from 18 GHz

Differences in propagation and susceptibility to rain fade create significant challenges to preserve viability of business

- Additional free space loss equal to 2.3 dB
- Additional rain attenuation loss of 9.5 dB
- Additional transmitter power loss of 1.0dB
- Requires total link budget performance improvement of 12.8 dB.

Viable Parameter Adjustments

These considerations can contribute to mitigating for system loss.

- **Transmit Power:** At 24 Ghz it is difficult to maintain the same transmit power as at 18 ghz. Any power increase will add to both cost and time to re-design the system.

- **Antenna Gain:** Same size antenna will provide increased gain at 24 Ghz.

- **Modulation:** less complex schemes require lower Eb/N0 and can propogate greater distances with same reliability.

- **Bandwidth Allocation across subscriber links:** Fixed (FBA) rather than dynamic allocation of bandwidth (DBA) among subscriber links allows for reduced backoff in transmitter power amplifier due to reduced number of carriers.

Link Improvement Due To Parameter Adjustments

A combination of antenna gain, lower order modulation scheme and fixed bandwidth allocation is necessary to compensate for performance differences

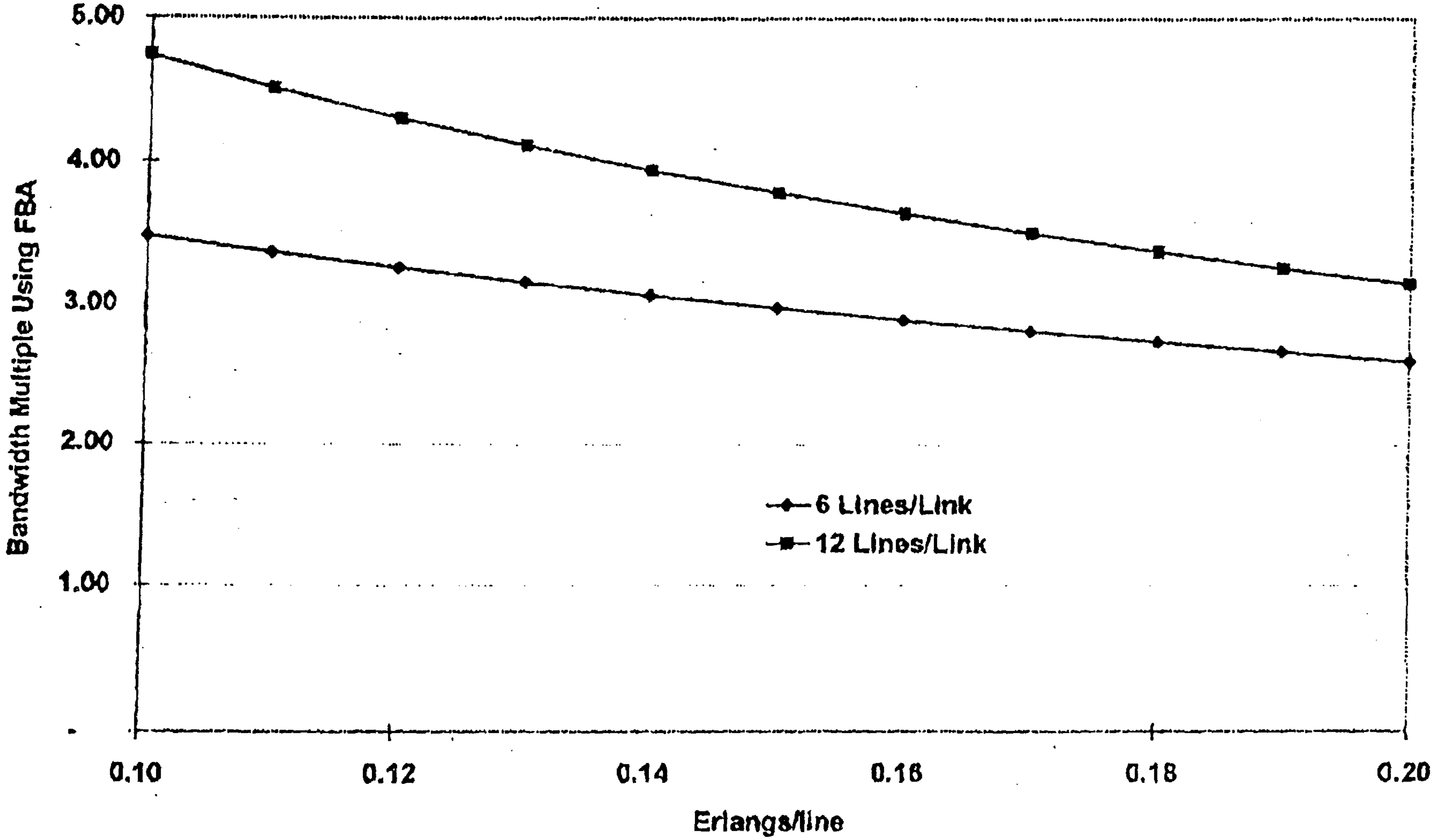
Antenna Gain	Same size as at 18 Ghz	**+ 2.3dB**
Modulation	Use QPSK 1/2 instead of 16-TCM	**+ 7.0 dB**
Bandwidth Allocation	Use fixed rather than dynamic allocation	**+ 4.0 dB**
Total improvement in link performance		**+ 13.3 dB**
System Loss		**-12.8 dB**
Link Budget Margin		**=+0.5dB**

Comparison of Modulation Efficiency

Using QPSK 1/2 to maintain coverage at 24 GHz requires 3.0 times the spectrum when compared to 16-TCM.

Modulation	Bit Rate/1Hz	Required Bandwidth (for bit rate = n bps)
16-TCM	*2.4 bps/Hz*	*1/2.4=.416Hz x n*
QPSK 1/2	*0.8 bps/Hz*	*1/.8=1.25Hz x n*

Bandwidth Multiple Required
Due to Using FBA Instead of DBA



Composite Impact of Moving From 18 GHz to 24 GHz

Various combinations of modulation and bandwidth allocation schemes to meet coverage, capacity, reliability, and cost performance at 24 GHz will require 4 times the spectrum. The following scenarios demonstrate the bandwidth required using various combinations:

- **Case #1**: 16-TCM *FBA;* QPSK1/2 *FBA*
- **Case #2**: 16-TCM *DBA*; 16-TCM *FBA*; QPSK1/2 *FBA*

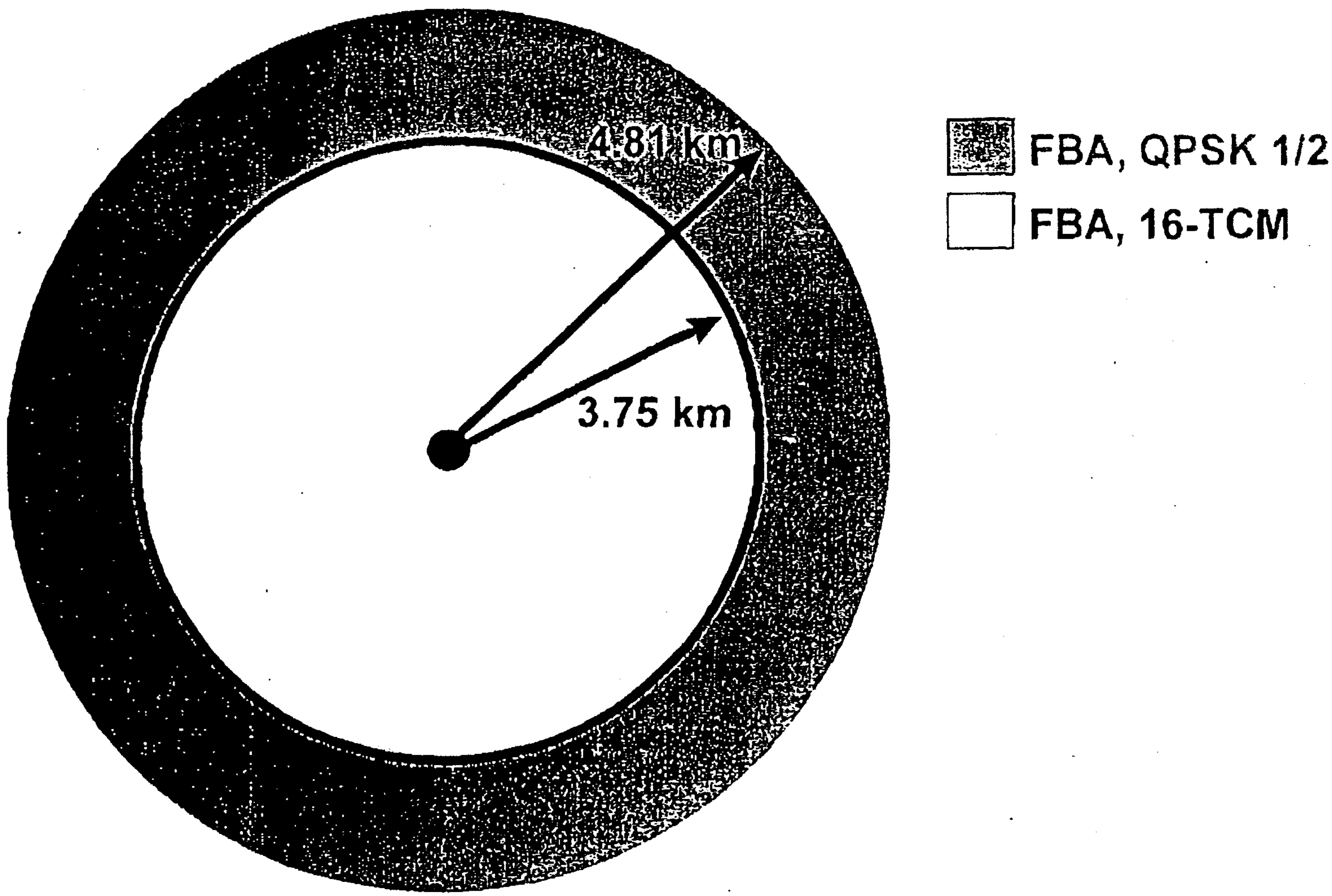
Composite Impact of Moving From 18 GHz to 24 GHz

Case #1:

Modulation		Cell Radius	Total Area	% of Cell Area Served	Mod. Factor	DBA Factor	Relative Bandwidth
16-TCM	*FBA*	3.75	44.16	60.78%	1.0	2.59	1.57
QPSK 1/2	*FBA*	4.81	72.65	39.22%	3.0	2.59	3.05

Total Amount of Spectrum Required **4.62**

Case #1:
Modulation and FBA Cell Radii at 24 GHz



Composite Impact of Moving From 18 GHz to 24 GHz

Case #2:

Modulation		Cell Radius	Total Area	% of Cell Area Served	Mod. Factor	DBA Factor	Relative Bandwidth
16-TCM	*DBA*	2.84	25.33	34.86%	1.0	1.00	0.35
16-TCM	*FBA*	3.75	44.16	25.92%	1.0	2.59	0.67
QPSK 1/2	*FBA*	4.81	72.65	39.22%	3.0	2.59	3.05

Total Amount of Spectrum Required ***4.07***

Case #2:
Modulation and DBA/FBA Cell Radii at 24 GHz